

Human Exposure to PBDEs, with Heather Stapleton

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Flame retardants known as polybrominated diphenyl ethers (PBDEs) are added to products such as furniture, car seats, textiles, and electronics. These chemicals improve safety by giving consumers more time to react if a fire breaks out. But now they are also showing up in the food we eat, the dust in our houses, and the bodies of possibly the entire U.S. population; meanwhile, recent evidence suggests the potential for worrisome neurodevelopmental effects. In this podcast, Heather Stapleton discusses what we know about routes of PBDE exposure and how these exposures may affect human health. Stapleton is an assistant professor of environmental chemistry at the Nicholas School of the Environment at Duke University and coauthor of “Metabolism of polybrominated diphenyl ethers (PBDEs) by human hepatocytes *in vitro*”

AHEARN: It's *The Researcher's Perspective*. I'm Ashley Ahearn.

Flame retardant chemicals can be found in everything from kids' car seats to the cushions in your old living room couch.

The bad news is that they can probably also be found in *you*.

According to the Centers for Disease Control and Prevention, PBDEs—or polybrominated diphenyl ethers—show up in the bodies of almost 100% of the U.S. population,¹ and they may be negatively affecting human health and development.

Joining me to talk about PBDEs is Dr. Heather Stapleton. She's an assistant professor of environmental chemistry at the Nicholas School of the Environment at Duke University.

Dr. Stapleton, thanks for being here.

STAPLETON: You're welcome. Thank you for having me.

AHEARN: Ok, let's start with some chemistry here. What are PBDEs, and what makes them flame retardants?

STAPLETON: A PBDE is a man-made—anthropogenic—chemical, and they are produced by companies throughout the world and then sold to manufacturers of certain products that require flame retardants. So as you have increasing temperatures with fire, what happens is that the bond that keeps the bromine to the molecule breaks; it decomposes and releases bromine to the surrounding environment and to the atmosphere. And bromine is a very effective scavenger of free radicals. So by scavenging these free radicals, you're basically reducing the potential of the fire to propagate, so it basically smolders out. And so that's how these PBDEs, when they're present in such products as foam in your furniture or in your plastic for your electronics, helps to reduce their inherent flammability.

AHEARN: So they're in almost 100% of Americans. How did they get there? How did they get into our bodies?

STAPLETON: That's a big area of research that scientists are still trying to understand. We know for a fact that PBDEs are ubiquitous. They are found in a lot of our food products. They're found in the air in our home. They're found in the dusts in our home at fairly high levels relative to levels in the outdoor environment. There is definitely an exposure pathway from the presence of these products in our home and through our diet. Research definitely shows we're getting exposure from both avenues.

AHEARN: There was a study that was recently published in *Environmental Health Perspectives* that found that higher levels of PBDEs were found in people who eat a lot of meat.² So what's going on there?

STAPLETON: People have looked at the levels of PBDEs in our foods. So if you were to go and collect some of these food items like meat and dairy products and vegetables and fruits, and you took them into a lab and you analyzed them, you would find very low

levels of PBDEs in most of these products. But there does seem to be some evidence suggesting that very fatty, meaty products have higher levels than something like your fruits and vegetables because they [PBDEs] concentrate in the fatty tissues, and then when we consume these fatty tissues, they accumulate in our fatty tissues.

AHEARN: So who is most at risk for PBDE exposure?

STAPLETON: Well, certainly children are most at risk because children have greater contact with the floor. They—particularly young infants and toddlers—they crawl around on the floor, they're constantly putting their hands in their mouth or their toys in their mouth, and their hands and these toys often have dust particles on them, so they're coming into contact with the dust particles in our home. It's very similar to the exposure paradigm that was developed for lead. There's been a lot of concern about lead exposure in children because lead can accumulate in dust from its historical use in paints, and PBDEs seem to be following that model or that paradigm, and so we're seeing accumulation in dust and likely transfer to these children that have contact with the dust. And several studies have now shown that concentrations of PBDEs in children, particularly young children, are significantly higher than they are in adults. So this is certainly a concern, because children are at these very sensitive developmental stages, and they could be more prone, or more vulnerable, to adverse health effects than an adult would be.

AHEARN: Body burdens of PBDEs in the U.S. are also significantly higher than body burdens in Europe. Could you talk a little bit about that?

STAPLETON: Yes. The levels in the U.S. and the Canadian populations are significantly higher than they are in, let's say, European countries, and this is believed to result from the greater use of one specific PBDE commercial mixture in the U.S. and Canada, and that commercial mixture is known as pentaBDE. This was a flame retardant mixture that was used primarily in polyurethane foams, so the foam found in chairs and couches and futons and things of that nature. So in North America, primarily the U.S. and Canada, we

use approximately 98% of the global consumption of pentaBDE, and this has led to higher concentrations of pentaBDE in our dust, and this is reflective of the differences in body burdens between the U.S. and European countries. So there is exposure from diet, but the indoor exposures from indoor air and indoor dust are certainly significant.

AHEARN: What might PBDEs be doing to humans?

STAPLETON: So . . . there's a lot of research trying to understand the human health impacts from exposure to PBDEs. There's a weight of evidence suggesting there's impacts on both neurodevelopment, neurobehavior, and also on thyroid hormone regulation. A few studies that have been published in the last few years suggest that exposure to PBDEs can affect IQ potential in children that have been exposed *in utero*.³ There's been studies suggesting that exposure to PBDEs will affect the time it takes a woman to become pregnant.⁴ There was a study that was published in Europe, I believe, where they found that higher PBDE levels in a mother's breast milk were significantly associated with the increased incidence of cryptorchidism in male infants, which is when you have undescended testicles.⁵ So there are certainly some human health end points that are being observed in the scientific studies over the past few years. And then there's studies showing impacts on thyroid regulation. And these have been observed both in laboratory animal exposure studies⁶ and in a few of the human studies⁷ as well. And thyroid hormones are very important in growth and development, particularly for children, because they do influence the developing brain. So this is certainly of concern, particularly in light of the fact that the incidence of neurodevelopmental problems in children is increasing over the past few decades.

AHEARN: So Dr. Stapleton, how are PBDEs regulated now?

STAPLETON: Well, it varies by area and by region. PBDEs are regulated in the European Union. They were phased out in 2004—both the penta- and the octaBDE formulations, and more recently the deca- —but in the U.S. it's a little bit of a different story. There have been no federal regulations against PBDEs, but several U.S. states did

phase out the use of penta- and octaBDE as long ago as 2004, and then recently several states have phased out or banned the use of decaBDE when suitable alternatives can be found. However, some of the major chemical manufacturers have also agreed to voluntarily phase out production of the PBDE formulations.

And Congress is taking up this issue as well and will be having a hearing to investigate the uses of flame retardants by the three main chemical manufacturers where they will discuss both the benefits and the potential health hazards from using these flame retardants in consumer products.

AHEARN: Do you have any kids?

STAPLETON: I do. I have an 11-month-old son, and I constantly think about his exposure to flame retardants in my home, I have to admit.

AHEARN: Yeah, I bet you're one of the more paranoid moms around, huh?

STAPLETON: [LAUGHING] Yes.

AHEARN: Or maybe your friends see you as paranoid; you know you're not.

STAPLETON: [LAUGHING] That's right. Yeah. I think my husband thinks I'm a little paranoid. But you know what, it is a concern, and I've been particularly concerned about the number of baby products that have flame retardants in them. So as a parent and as a consumer, you don't have a choice when you go into the store and you want to buy a nursing pillow or a portable crib mattress or a changing pad for your changing table. Probably more than 80% of these baby products have flame retardants in them. Almost all of them that we've detected to date are halogenated, meaning they contain either chlorinated or brominated flame retardants in them. But over half of them actually contain what we call chlorinated Tris, which was one of the flame retardants used in children's pajamas back in the 1970s, and they were eventually phased out over concerns

about their potential absorption through the skin and their potential carcinogenicity. So there's no doubt that we are now being exposed to not only PBDEs but chlorinated Tris and several other flame retardants as well, and, again, this is certainly a concern for children.

AHEARN: At the end of the day, what's to be done about PBDEs, and how should parents or consumers be reacting to this information?

STAPLETON: I get this question asked all the time. I have people that will call me up in my office and ask me, "What's the best way to prevent my child from being exposed to flame retardants?" And it's a very difficult question to answer. I mean, there are simple things we could try to do by getting rid of our carpets and having hardwood floors—carpets will trap dust particles—or inquiring more about flame retardants in our consumer products, right? And this is the best way to get the problem addressed is to— by forcing more attention on the manufacturers to maybe find new ways to make these products inherently flame retardant without using chemical additives. PBDEs is going to be an issue we're going to be dealing with for decades. It's going to be a long-term saga and a long-term story that won't end any time soon.

AHEARN: Dr. Stapleton, thanks for being here.

STAPLETON: You're welcome. Thank you for having me.

AHEARN: Dr. Heather Stapleton is an assistant professor of environmental chemistry at the Nicholas School of the Environment at Duke University.

And that's *The Researcher's Perspective*.

I'm Ashley Ahearn. Thanks for downloading!

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